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chords CD, $C'D'$. $\angle CEG=\angle BCA=\angle ACC'=\angle CC'G$, hence the triangle $CC'E$ is isosceles and $C'G=GE$. Since CE is parallel to the axis of the parabola and AC is parallel to $C'D'$, E bisects $C'D'$. Hence $C'G=\frac{1}{4}C'D'$, or $C'G=\frac{1}{3}GD'$. In the same way it may be shown that $CG=\frac{1}{3}GD$. Therefore the triangles $C'CG$ and DGD' are similar. It follows easily now that CC' and $D'D$ are parallel and $CC'=\frac{1}{3}D'D$.

Also solved by G. B. M. Zerr, and J. Scheffer.

223. Proposed by **W. J. GREENSTREET, A. M.,** Editor of The Mathematical Gazette, Stroud, England.

Find a point C in a given line AB, so the lines joining C to the angular points of a triangle PQR coplanar with the given line may cut off on any line parallel to the given line and lying in the same plane two equal segments.

Solution by **G. W. GREENWOOD, B. A. (Oxon),** Professor of Mathematics and Astronomy in McKendree College, Lebanon, Ill., and **W. W. LANDIS,** Dickinson College, Carlisle, Pa.

AB cuts any one of the sides of the triangle produced, say PQ, in X. Determine the point harmonically separated from X by P and Q and call this point Y. The line joining R and Y cuts AB in the required point C. For the sheaf CX, CP, CY, CR being harmonic it is cut by any line parallel to CX in four harmonic points one of which is at infinity, therefore the remaining three points intercept equal segments.

Also solved by F. D. Posey, San Mateo, Cal.; R. A. Wells, Bellevue, Neb.; and G. B. M. Zerr, Parsons, W. Va.

CALCULUS.

176. Proposed by **B. F. FINKEL, A. M., M. Sc.,** 204 St. Marks Square, Philadelphia, Pa.

Show by any method, Riemann's excepted, that

$$\int_0^\infty e^{-x^2}\cos\frac{b^2}{x^2}dx=\tfrac{1}{2}\sqrt{(\pi)}e^{-b\sqrt{2}}\cos b\sqrt{2}.$$

Remark by **S. A. COREY,** Hiteman, Iowa.

Solved by Dr. G. B. M. Zerr in his paper entitled *On the Evaluation of Certain Definite Integrals* in the MONTHLY of March, 1904, page 57, §2.

177. Proposed by **O. W. ANTHONY,** Head of Mathematical Department, DeWitt Clinton High School, New York City.

Find the volume of the minimum cone which can be circumscribed about a hemisphere.

Solution by **A. H. HOLMES,** Brunswick, Maine, and **S. A. COREY,** Hiteman, Iowa.

Let x=altitude of cone, r=radius of sphere, R=radius of base of cone, θ=angle between x and the line joining vertex and circumference of base of cone. Then, from similar triangles, $x=r/\sin\theta$, $R=r/\cos\theta$.

Volume V of cone is, $V=\pi R^2x/3=\pi r^3/3\cos^2\theta\sin\theta$.

When V is a minimum, $dV/d\theta=0$, which condition is satisfied when $\sin\theta=\sqrt{\frac{1}{3}}$, *i. e.*, $V=\frac{1}{2}(\pi r^3\sqrt{3})$.

Also solved by R. A. Wells, J. E. Sanders, G. W. Greenwood, W. W. Landis, G. B. M. Zerr, E. L. Sherwood, J. Scheffer, and L. E. Newcomb.

MECHANICS.

167. Proposed by EDWIN S. CRAWLEY, Ph.D., Professor of Mathematics in the University of Pennsylvania.

An anchor ring or torus is produced by the revolution of a circle of radius r, the center of the revolving circle describing a circle of radius R. A quadrant of the torus is cut by two planes through the center of the ring perpendicular to each other and perpendicular to the plane of revolution. Determine the limiting value of the ratio $R:r$, so that when the quadrant thus formed is placed with one of its ends in coincidence with a horizontal plane it will rest in that position.

I. Solution by G. W. GREENWOOD, B. A. (Oxon), Professor of Mathematics and Astronomy in McKendree College, Lebanon, Ill.

The center of gravity of the quadrant is at a distance d from the axis of revolution where $d=(4R^2+r^2)/\pi R\sqrt{2}$ [Routh's *Statics* (second edition), Vol. I, ex. 4, p. 280].* The limiting ratio of R to r is given by $d/\sqrt{2}=R-r$, whence $4R^2+r^2=2\pi R(R-r)$; and $R/r=2.9+$.

II. Solution by B. F. FINKEL, Fellow in Mathematics, University of Pennsylvania, Philadelphia, Pa.

The equation of the surface of the ring is $\rho=R\sin\phi\pm\sqrt{(r^2-R^2\cos^2\phi)}$, when r is the radius of a cross-section of the ring and R the radius of the path of the center of gravity of the generating circle. Then

$$\bar{x}=2.\frac{\int\sigma x dV}{\int dV},$$

where σ $(=1$, say) is the density dV and element of volume, and x the distance from the y-axis to this element of volume.

Then $dV=\rho^2\sin\phi\, d\rho\, d\theta\, d\phi$,

$x=\rho\sin\phi\cos\theta$, and

$\int dV=2\pi R.\pi r/4=\frac{1}{4}\pi^2r^2R$. Hence

$$\bar{x}=\frac{4}{\pi^2r^2R}\int_{\cos^{-1}(r/R)}^{\frac{1}{2}\pi}\sin^2\phi\, d\phi\int_{R\sin\phi-\sqrt{(r^2-R^2\cos^2\phi)}}^{R\sin\phi+\sqrt{(r^2-R^2\cos^2\phi)}}\rho^3 d\rho\int_0^{\frac{1}{2}\pi}d\theta$$

$$=\frac{8}{\pi^2r^2}\int_{\cos^{-1}(r/R)}^{\frac{1}{2}\pi}[\sin^3\phi(2R^2\sin^2\phi+r^2-R^2)\sqrt{(r^2-R^2\cos^2\phi)}]d\phi.$$

Let $\cos\phi=(r/R)\cos\psi$; then the last equation reduces to

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*See also Bowser's *Analytical Mechanics*, 9th ed., p. 112.